tion the later work of Halphen, Nöther, Valentine, and Hilbert. These authors make considerable use of Cayley's conception of the monoid surface, the curve being regarded as the partial intersection of a cone with a monoid surface; Halphen obtained the fundamental theorem which shows the existence of a monoid surface of order $n+1$, where n is the order of the cone of lowest order which passes through all the nodal lines of the aforesaid cone. Important remarks are made on the theory arising from this notion. In the Professor's view, the question of the *classification* of curves in space, according to the representation, as the partial intersection of a cone and a monoid surface is that which properly first presents itself.

There are many papers on geometry, including those on "skew surfaces" and "sextactic points of a plane curve," with which all geometricians are familiar.

The paper No. 347, "On the Notion and Boundaries of Algebra," considers in particular the line of separation between finite and transcendental analysis. The views of so eminent a man on this subject are necessarily of interest and importance. In stating algebra to be both an art and a science, the author is in agreement with the constantly reiterated opinion of Prof. Sylvester, and indeed with that of the great majority of those who have made algebra a subject of special study. The two great divisions of algebra are stated to be "tactic" and "logistic," and the remark is made that every algebraical theorem rests, ultimately, on a tactical foundation. Mathematicians will, we think, perceive in the word "tactic" a singularly felicitous expression to denote those operations which relate to arrangement of material.

The paper No. 312, "On the Partitions of a Close," generalises Euler's polyhedral relation,

$$F + S = E + 2$$

and is a first step towards Listing's well-known developments.

The frontispiece of vol vi. is a portrait of Prof. Cayley, attired in gown, seated at his desk in the act of writing. The picture is somewhat dark and not quite so pleasing as those which of recent years have appeared in NATURE and in the *American Journal of Mathematics*. The volume is principally on geometry. The memoir No. 412, on "Cubic Surfaces," adopts a classification depending on the nature of the singularities. In the notes the notation is compared with that of Zeuthen, and several apparent discrepancies in the results are explained.

There is a long memoir on the polyzomal curves

$$\sqrt{U} + \sqrt{V} + \dots = 0$$

U, V, &c., being rational integral functions of the same degree in the variables. The general v-zomal curve (*i.e.* v functions U, V, &c.) is considered, and the branches, singularities, order, class, &c., determined. The investigation is intimately connected with Casey's work, on Bicircular Quartics, published in 1867 in the Proceedings of the Royal Irish Academy.

Other geometrical subjects considered are "Reciprocal Surfaces," "Skew and Developable Surfaces," "Abstract Geometry," "Cubical Divergent Parabolas," &c. In analysis we have the eighth memoir on quantics, which relates chiefly to the binary quintic; and, finally, mention may be made of the reproduction of Euler's memoir of 1758, on the rotation of a solid body.

The number of papers which appear in the six volumes is 416. Several hundreds of papers have yet to appear, and it seems improbable that a total of ten volumes will be found sufficient. This improbability is increased from the circumstance that Prof. Cayley is still producing a considerable amount of mathematical work.

For excellence of mathematical printing, and general care of production, unstinted approval may be awarded to the Cambridge University Press. These handsome volumes, as they appear, are rearing a fitting monument of the work of an eminent man, and are causing gratification and congratulation amongst mathematicians the world over.

P. A. MACMAHON.

THE PAMIRS.

The Pamirs: being a Narrative of a Year's Expedition on Horseback and on Foot through Kashmir, Western Tibet, Chinese Tartary, and Russian Cental Asia. By the Earl of Dunmore, F.R.G.S. In two volumes. (London: John Murray, 1893.)

LORD DUNMORE embodies in these volumes the journal of a somewhat remarkable journey of a year's duration, the initial and terminal points of which were Karachi and Constantinople. During most of the time he was accompanied by Major Roche, and the object of the journey was sport, especially the pursuit of the *Ovis poli*. Unfortunately this great sheep—of which Lord Dunmore (vol. ii. p. 56) appears to doubt the ovine character—inhabits a country the political geography of which is still undergoing spasmodic evolution, and there is reason to suspect the censorship of the Indian Government on all English writings bearing on the region. Thus we cannot expect any great contributions to the detailed topography of the Pamirs to be made public, and as the author makes no claim to any scientific acquirements, the botany and geology of the vast tracts wandered over are left no clearer than they were before. Major Roche, however, made an entomological collection. It is deeply to be deplored that every traveller, who is so fortunately circumstanced as to be able to push his way where few intelligent Europeans have been before, should not make some sort of preparation to fit himself for utilising his rare opportunities. For such preliminary instruction in science the Royal Geographical Society has made ample provision specially adapted to the wants of travellers, and as years go on we trust that the imputation of ignorance of what and how to observe may no longer be the necessary prelude to the criticism of works of travel in a scientific journal. Major Roche was fortunately provided with a camera, and made splendid use of it, although most of his negatives were unfortunately destroyed. Lord Dunmore himself is something of an artist, and much value must be attached to the landscapes which illustrate his book. Both travellers carried aneroids and, presumably, some surveying instruments, as a map with several new features is one of the results of the journey. We may point out that the larger-scale map of the Pamirs should have been bound with vol. ii., in which alone that region is discussed, while the general map showing the route to Yarkand would be more useful in vol. i. One other criticism must be made before turning to the pleasanter consideration of the merits of the work. Native words are introduced in unnecessary profusion, and although *akoi, jigit, puttoo,* and seventy-five other uncouth terms are interpreted in a glossary considerately prefixed to each volume, we can only guess darkly from the context the significance of *chikore, chit,* and *fank,* to mention only a few we have puzzled over.

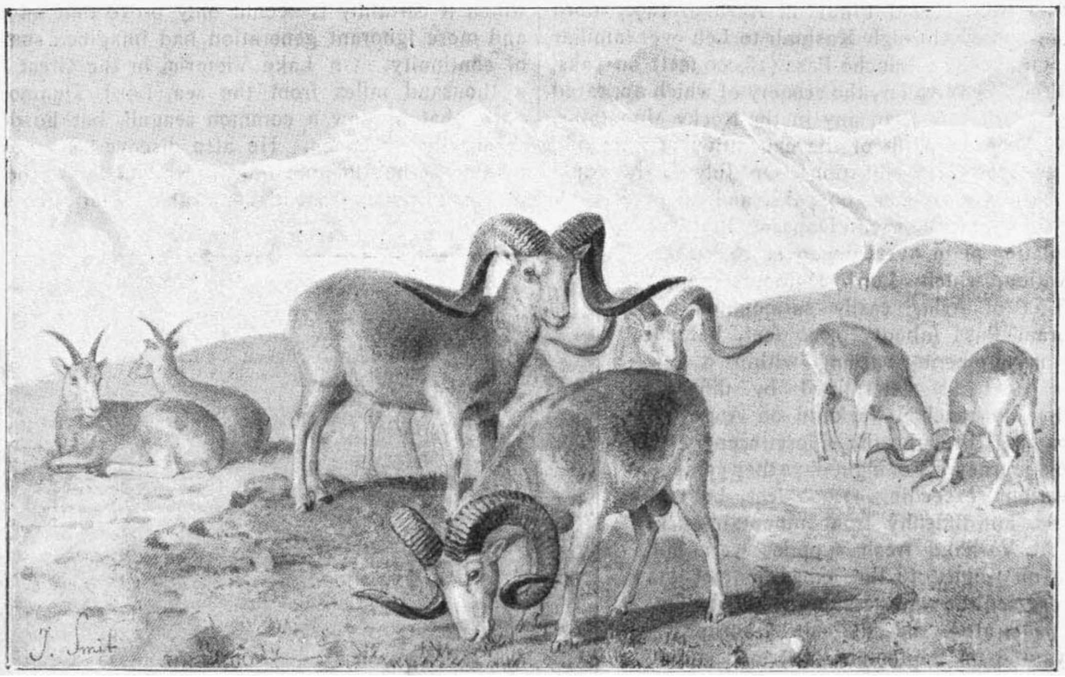

FIG 1.—Ovis Poli.

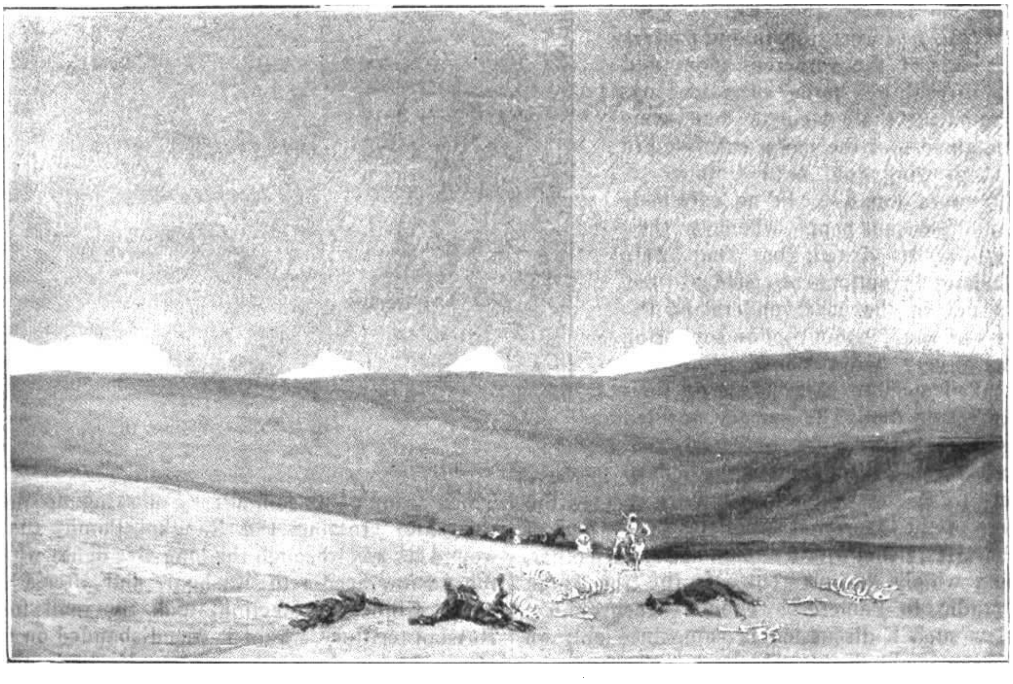

FIG. 2.—The Roof of Asia, plateau 18,000 feet above sea-level.

Lord Dunmore has travelled extensively in many parts of the world, and he is able to brighten his descriptions by many shrewd comparisons with distant places and diverse peoples. His power of description is above the average of the sporting traveller, and from first to last the two volumes may be read with pleasure and with profit. It is particularly pleasing to notice the reticence regarding his own doings, and the generous recognition given to his native attendants and the merchants and officials who showed his party kindness by the way.

Starting from Rawal Pindi on April 9, 1892, Lord Dunmore passed through Kashmir to Leh over familiar ground, climbed the Laoche Pass (18,000 feet) on yaks, crossed the Shyok valley, the scenery of which appeared on a grander scale than any in the Rocky Mountains, and completed the outfit of the expedition at Panamik, the last outpost of civilisation. On July 1, the expedition, including 30 men, 60 yaks, and 56 ponies, left Panamik, crossed the great Dapsang Plateau, an undulating plain averaging over 16,000 feet of elevation, which Lord Dunmore names "the Roof of Asia," easily surmounted the Karakoram Pass (about 19,000 feet, but all these measurements varying within a few hundred feet as determined by different aneroids), and reached Yarkand on August 4, after passing through the finest scenery of the whole journey. For eight days they camped at elevations exceeding 17,000 feet, but experienced no difficulty from mountain sickness. At Yarkand fresh supplies were laid in, and on August 18 the expedition set out again, crossed the waterless desert of Shaitankum, penetrated the difficult "Sariq-qol" country, and on September 6 formed a permanent camp in the Kukturak valley of the Taghdumbash Pamir, at an elevation of 15,000 feet. It was too late in the year for good sport, as the *Ovis poli* were able to find pasture close to the edge of the perpetual snow, and were often driven by herds of wild dogs right up amongst the glaciers; but some sport was obtained and the camp inhabited in spite of the growing cold until October 30. The Kirghiz were found to be an extremely hospitable and pleasant people whenever their encampments were visited, but they were curiously lacking in notions of space or time. They could not in the least understand the laboriousness of the Tibetan coolies, supposing that only as a very heavy punishment could people be called upon to carry loads on their heads, or travel on foot. The journey now led zig-zagging across the Pamirs, in bitterly cold weather, past frozen lakes and along the beds of frozen rivers to Kashgar. Lord Dunmore crossed the source region of the Oxus, and speculates as to which of several tributaries, rising within a few miles of each other, but pursuing widely devious routes, is the true "high mountain cradle in Pamere." From a geographical point of view such a discussion is vain, since only an accurate survey could decide which stream of all the streams was the longest, highest, or possessed of the greatest drainage area, and then it is a matter of hair-splitting definition to determine whether one or another of several nearly equal tributaries should retain the name of the main stream. There is, we imagine, no system akin to primogeniture which could discriminate the rights of the twin or triplet sources of the Amu-daria to exclusive physical continuity with the mature river in which they all converge. The similarity of the name Aksu, which belongs to one of them, with the name Oxus, even if, as Lord Dunmore urges, not accidental—which it certainly is—could only prove that an earlier and more ignorant generation had imagined some sort of continuity. On Lake Victoria, in the Great Pamir, a thousand miles from the sea, Lord Dunmore reports that he saw a common seagull, but he did not secure the specimen. He also discovered a new pass leading to the Alichur Pamir, to which he gave the name of Hauz Dawan, from a remarkable cistern-like lakelet which occupied its summit. Following up the Alichur river and crossing the Rangkul Pamir, the caravan wound its way through the long Gez defile which forms the narrow access to Kashgar, and after a short stay under Chinese protection, took the road to Osh, in Russian territory, where it was disbanded on January 1, 1893. Major Roche returned to Kashmir, the Russian officials not allowing him to cross the frontier, and Lord Dunmore proceeded by tarantass and sledge through Khokand and Tashkent to Samarkand, whence the trans-Caspian Railway brought him back to Europe.

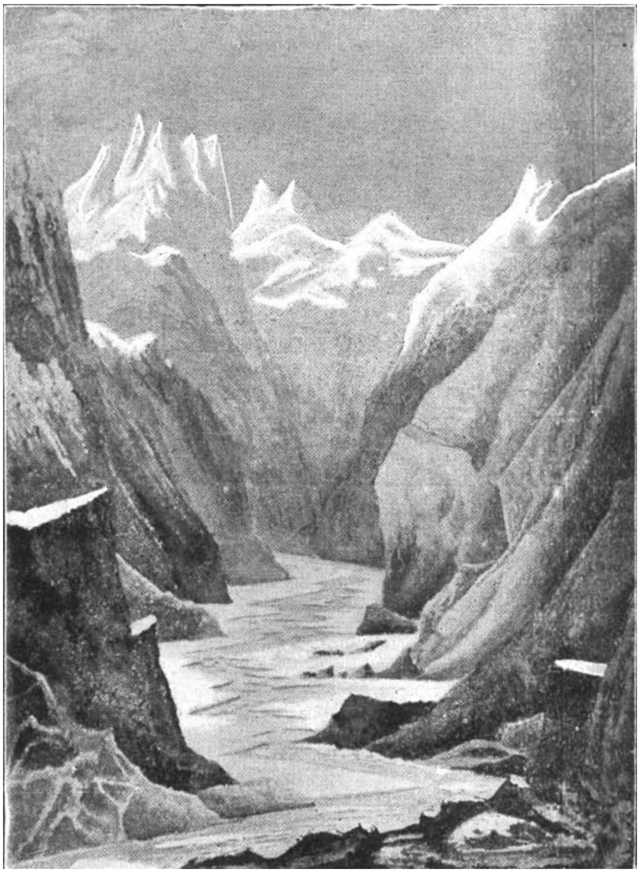

FIG. 3.—The Gez defile.

The meteorological data obtained are incomplete, as the registering thermometers were only graduated to

−20° F., and could not be left outside the tents at night for fear of damage to the index by the low temperatures experienced. They are not tabulated, nor is there a detailed itinerary, but an interesting appendix shows graphically the heights of the various passes as compared with the summit of Mont Blanc.

The illustrations reproduced are selected from a profusion of admirable pictures. Fig. 1 represents the *Ovis poli* in their summer feeding-grounds close to the snow-line, and the others are typical of the most impressive plateau and gorge scenery of the region.

THE GENUS MADREPORA.

Catalogue of the Madreporarian Corals in the British Museum (*Natural History*). Vol. I. "The Genus Madrepora." By George Brook. (London, 1893.)

IT is with feelings of sad regret that we turn over the pages of this monograph. Mr. Brook laboured long and hard at the book, carried it through the press, but did not live to see his labours recognised by his colleagues. His sudden and premature death has already been noticed in NATURE (vol. xlviii. pp. 376, 420), and the present writer would like to add his testimony to the accurate and painstaking character of the work of George Brook. Happily free from pecuniary anxiety, he was able to, and did, devote his time to scientific work without regard to its paying qualities, either as to money or to immediate scientific reputation.

The monograph now under review was to be the first of a series of memoirs on the classification of the Madreporaria which were to form part of the great series of the catalogues of the British Museum. As a detailed account of the anatomy of soft parts, of histology, and of morphological problems is foreign to the general plan of this series, we must not expect to find these subjects fully dealt with in this volume; but Mr. Brook does give a succinct account of the anatomy of the genus Madrepora, so far as is at present known. For some years Mr. Brook had been studying the anatomy of the Madreporaria, and in due time he would have published his results, which would have been of great value. It is to be hoped that what has already been accomplished by him, but not yet published, will not be lost to science.

The name Madrepora appears to have been first used by Imperato in 1599; but its precise significance, or rather the sense in which the term was originally employed, does not appear to be generally understood. Imperato clearly regarded what we now speak of as the "corallum" as a stony "nurse," in the porous cups of which animal polyps undergo their development, and "stony mother" appears to indicate the meaning intended. There is no doubt that the word is, in the first instance, Italian, and Linnæus applied it to the same group of zoophytes as Imperato had done. As, however, the term was originally used to indicate the "maternal" character of the "stone" rather than its porosity, it appears that the root should be referred to the Greek πῶρος, *i.e.* stone, and the English pronunciation of the word altered accordingly. There is no need to detail here the complicated synonymy of the name; it is evident that its retention depends for its justification on custom rather than on priority. Dana and all subsequent writers, except Ehrenberg, have followed Lamarck who retained Linnæus's name for non-typical species (*M. muricata*) of the original species. Ehrenberg proposed in 1834 a new name (Heteropora) for the restricted genus as we now know it, but unfortunately his name had been preoccupied by Blainville. Prof. F. Jeffrey Bell (*A. N. H.* viii. 1891, p. 109) has also shown that the name "Holothuria" is in an analogous position. In these and similar cases, good sense, rather than a rigid adherence to rules of priority, should determine the retention of a well-known name, especially when zoologists are agreed as to the forms which are included under the term in question; but in the great majority of cases it is better to adhere to the generally accepted rules.

Dr. Duncan (*A. N. H.*, 1884, p. 181) has given an account of the structure of the corallum in three varieties of growth. As was to be expected, the quick-growing species have a lax tissue, while the slow-growing forms are very dense. Mr. Brook objects to the use of the term "costæ" for the external longitudinal ridges on the wall. The porous corallite wall is essentially composed of synapticulæ, and is therefore not a theca, as it differs both in structure and origin. According to G. von Koch's view of the origin of a theca, costæ are to be regarded as the distal extremities of septa which pass beyond the thecate wall. In the genus Madrepora the so-called costæ undoubtedly do not come under this category. They appear before the septa, and bear no regular relation to them, either in number or position.

Although the Anthozoa are generally regarded as typical radiate animals, those who have studied their embryology and anatomy recognise a fundamental bilateral symmetry which is masked by the tendency to a radial habit which characterises sessile forms. The typical number of septa is 12, viz 6 primary and 6 of a second cycle, which is usually less developed; rarely a third cycle occurs; in many species the primary cycle alone is present. The septa are generally most fully developed in the axial corallites. It is often stated as characteristic of the genus Madrepora that the axial or directive septa are more prominent than the other primary septa; but this is by no means always the case, nor is that condition confined to the genus. Whilst in axial corallites the most usual arrangement is for the primary septa to be sub-equal, in the radial corallites the directive septa are most frequently better developed—either stouter or broader—than the other primaries. In certain groups of species, however, the outer directive septum is more important than the inner; and in case only one septum is present, it is invariably the outer directive. It appears that in these cases the corresponding tentacle is longer than the remaining eleven.

For a knowledge of the soft parts, we are mainly indebted to Dr. Fowler (*Q. J. M. S.* xxvii. 1886, p. 1), although Mr. Brook did not omit to make investigations on his own account. The structure of the polyp is, in its general features, Actinian, but there is a marked bilateral